CLAIMS

1. A process for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, M is two or more and N is a positive integer equal to three or more, comprising

providing an M:N variable matrix,

applying said M audio input signals to said variable matrix,

deriving said N audio output signals from said variable matrix, and

controlling said variable matrix in response to said input signals so that a soundfield generated by said output signals has a compact sound image in the nominal ongoing primary direction of the input signals when the input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal, as the correlation continues to decrease to highly uncorrelated.

2. A process according to claim 1 wherein said M:N variable matrix is a variable matrix having variable coefficients or is a variable matrix having fixed coefficients and variable outputs, and said variable matrix is controlled by varying the variable coefficients or by varying the variable outputs.

3. A process according to claim 1 wherein said variable matrix is controlled in response to measures of:

(1) the relative levels of the input signals, and

(2) the cross-correlation of the input signals.

4. A process according to claim 3 wherein for a measure of cross-correlation of the input signals having values in a first range, bounded by a maximum value and a reference value, the soundfield has a compact sound image when the measure of cross-correlation is said maximum value and has a broadly spread image when the measure of cross-correlation is said reference value, and for a measure of cross-correlation of the input signals having values in a second range, bounded by said reference value and a minimum value, the soundfield has said broadly spread image when the measure of cross-correlation is said reference value and has a plurality of compact sound images, each in a direction associated with an input signal, when the measure of cross correlation is said minimum value.

5. A process according to claim 4 wherein said reference value is about the value of a measure of cross-correlation of the input signals for the case of equal energy in each of the outputs.

6. A process according to claim 3 wherein a measure of the relative levels of the input signals is in response to a smoothed energy level of each input signal.

7. A process according to claim 3 or claim 6 wherein a measure of the relative levels of the input signals is a nominal ongoing primary direction of the input signals.

8. A process according to claim 3 wherein a measure of the cross-correlation of the input signals is in response to a smoothed common energy of the input signals divided by the M^{th} root of the product of the smoothed energy level of each input signal, where M is the number of inputs.

9. A process according to any one of claims 6, 7 or 8 wherein the smoothed energy level of each input signal is obtained by variable-time-constant time-domain smoothing.

10. A process according to any one of claims 6, 7 or 8 wherein the smoothed energy level of each input signal is obtained by frequency-domain smoothing and variable-time-constant time-domain smoothing.

11. A process according to claim 8 wherein the common energy of the input signals is obtained by cross-multiplying the input amplitude levels.

12. A process according to claim 11 wherein the smoothed common energy of the input signals is obtained by variable-time-constant time-domain smoothing the common energy of the input signals.

13. A process according to claim 12 wherein the smoothed energy level of each input signal is obtained by variable-time-constant time-domain smoothing.

14. A process according to claim 11 wherein the smoothed common energy of the input signals is obtained by frequency-domain smoothing and variable-time-constant time-domain smoothing the common energy of the input signals.

15. A process according to claim 14 wherein the smoothed energy level of each input signal is obtained by frequency-domain smoothing and variable-time-constant time-domain smoothing.

16. A process according to any one of claims 9, 10, 12, 13, 14 and 15, wherein said variable-time-constant time-domain smoothing is performed by smoothing having both a fixed time constant and a variable time constant.

17. A process according to any one of claims 9, 10, 12, 13, 14 and 15, wherein said variable-time-constant time-domain smoothing is performed by smoothing having only a variable time constant.

18. A process according to claim 16 or claim 17 wherein said variable time constant is variable in steps.

19. A process according to claim 16 or claim 17 wherein said variable time constant is continuously variable.

20. A process according to claim 16 or claim 17 wherein said variable time constant is controlled in response to measures of the relative levels of the input signals and their cross-correlation.

21. A process according to claim 6 wherein the smoothed energy level of each input signal is obtained by variable-time-constant time-domain smoothing the energy levels of each input signal with substantially the same time constant.

22. A process according to claim 3 wherein the measures of the relative levels of the input signals and their cross-correlation are each obtained by variable-time-constant time-domain smoothing in which the same time constant is applied to each smoothing.

23. A process according to claim 8 wherein said measure of cross-correlation is a first measure of cross-correlation of the input signals and an additional measure of cross-correlation is obtained by applying a measure of the relative levels of the input signals to said first measure of cross-correlation to produce a direction-weighted measure of cross-correlation.

24. A process according to claim 23 wherein yet an additional measure of cross-correlation of the inputs signals is obtained by applying a scaling factor about equal to a value of a measure of cross-correlation of the input signals for the case of equal energy in each of the outputs.

25. A process for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, and M is three or more, comprising

providing a plurality of m:n variable matrices, where m is a subset of M and n is a subset of N,

applying a respective subset of said M audio input signals to each of said variable matrices,

deriving a respective subset of said N audio output signals from each of said variable matrices,

controlling each of said variable matrices in response to the subset of input signals applied to it so that a soundfield generated by the respective subset of output signals derived from it has a compact sound image in the nominal ongoing primary direction of the subset of input signals applied to it when such input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal applied to it, as the correlation continues to decrease to highly uncorrelated, and

deriving said N audio output signals from the subsets of N audio output channels.

26. A process according to claim 25 wherein said variable matrices are also controlled in response to information that compensates for the effect of one or more other variable matrices receiving the same input signal.

27. A process according to claim 25 or claim 26 wherein deriving said N audio output signals from the subsets of N audio output channels includes compensating for multiple variable matrices producing the same output signal.

28. A process according to any one of claims 25-27 wherein each of said variable matrices is controlled in response to measures of:

(a) the relative levels of the input signals applied to it, and

(b) the cross-correlation of the input signals.

29. A process for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, and M is three or more, comprising

providing an M:N variable matrix responsive to scale factors that control matrix coefficients or control the matrix outputs,

applying said M audio input signals to said variable matrix,

providing a plurality of m:n variable matrix scale factor generators, where m is a subset of M and n is a subset of N,

applying a respective subset of said M audio input signals to each of said variable matrix scale factor generators,

deriving a set of variable matrix scale factors for respective subsets of said N audio output signals from each of said variable matrix scale factor generators,

controlling each of said variable matrix scale factor generators in response to the subset of input signals applied to it so that when the scale factors generated by it are applied to said M:N variable matrix, a soundfield generated by the respective subset of output signals produced has a compact sound image in the nominal ongoing primary direction of the subset of input signals that produced the applied scale factors when such input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal that produced the applied scale factors, as the correlation continues to decrease to highly uncorrelated, and

deriving said N audio output signals from said variable matrix.

30. A process according to claim 29 wherein said variable matrix scale factor generators are also controlled in response to information that compensates for the effect of one or more other variable matrix scale factor generators receiving the same input signal.

31. A process according to claim 29 or claim 30 wherein deriving said N audio output signals from said variable matrix includes compensating for multiple variable matrix scale factor generators producing scale factors for the same output signal.

32. A process according to any one of claims 29-31 wherein each of said variable matrix scale factor generators is controlled in response to measures of:

(a) the relative levels of the input signals applied to it, and

(b) the cross-correlation of the input signals.